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SUGGESTIONS FOR THE IDENTIFICATION AND CONTROL OF AZALEA FLOWER SPOT

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Many inquiries are being received regarding the geographical distribution of azalea flower spot, varieties of azaleas affected, distinguishing characteristics of the disease, and especially the means of control.

It should be emphasized that azalea flower spot has been only recently recognized, and that the scientific investigation of it is not yet complete. Definite information obtained from experiments is especially lacking on control. In fact, it has not yet been possible to attain practicable control of the disease in any azalea planting where it has once become established, although some of the measures tried have been successful in delaying, or reducing the severity of infection. Furthermore, as new information is gained about the course of the disease and the life history of the causal organism, certain suggestions can be made that are based on experience with other similar diseases and that will probably prove applicable and beneficial in this instance also. It is the purpose of this article to summarize present information on this disease and suggest measures which may be tried in efforts to control or eradicate it, but these suggestions should not be taken as conclusive recommendations.

Where the disease occurs

Azalea flower spot has been observed in all the Southeastern and Gulf Coast States from North Carolina to Louisiana. It has been found only in plantings of cultivated azaleas located in cities and towns in the coastal area. It has not yet been observed north of Wilmington, N. C., nor west of Louisiana, nor in the hill or piedmont sections of the States indicated.

Distinguishing symptoms

Flower spot, or flower blight, shows its most conspicuous effects on the large-flowered horticultural azaleas usually known as Indian azaleas. It may occur also on the Japanese azaleas (Kurume, Kaempferi, Japonica, and various hybrids) but with less striking disease symptoms. The following description relates to its appearance on the Indian azaleas, especially such well known varieties as Formosa and Pride of Mobile.

The first sign of disease is the appearance of a few to many pale circular spots of pin-head size on the corolla or petals, best seen on the inner surface or face. If temperature and moisture conditions are favorable, the spots enlarge rapidly and develop irregular outlines; thus they may enlarge within a period of 24 hours from barely visible flecks to blotches one-eighth to one-fourth inch in diameter. The normal petal color is lost, the spots ap-

pearing pale and watersoaked on all pink, red and lavender flowers, but they are of a rusty brown color on white flowers. Within 3 days the spots may reach a size of one-half inch or more and the infected tissue becomes soft. This stage is appropriately termed limp blight, and may involve only one petal or the whole corolla. The final changes consist of further collapse and discoloration until the flowers look as if scalding water had been poured on them. The diseased flowers tend to cling to the twigs and usually do not drop off naturally.

Sometimes only a few flowers on a given bush will show these symptoms at one time, but the disease usually spreads from flower to flower until all are eventually infected. Sometimes all the flowers are attacked simultaneously, with the result that a beautiful bush in full flower is rendered most unsightly within a few days.

After the flowers are entirely blighted, the fungus that causes this disease produces resting bodies, termed sclerotia, in them. These sclerotia are flat or somewhat cup-shaped structures, from one-sixteenth to one-fourth inch broad, at first bluish-gray and soft, later becoming black and firm. They are distinctive of this disease, and no similar development occurs in flowers that are damaged by frost or sun-burn, or are infested with insect pests or other fungi. The sclerotia do not always form, however, and may not be found in flowers that cling to the twigs. As their production requires a moist atmosphere, a period of warm dry weather will stop the progress of the disease before the sclerotial stage is reached. In flowers that are infected after they have become aged, so that they drop off the bushes naturally without first undergoing limp blight, the sclerotia regularly form, the shade under the bush and the contact with ground providing the requisite moisture conditions.

Life cycle of the fungus that causes flower spot

The sclerotia lie dormant on the ground, or lightly covered with soil, under the bushes throughout the summer and early part of the winter. As the period of azalea bloom in late winter or early spring approaches, the sclerotia resume activity. After a period of wet weather when the temperature reaches 50° to 60° F., they start growth by producing one to several tiny mushroom-like bodies, termed apothecia. These have a stalk one-eighth to one-fourth inch long, and an expanded head usually less than one-eighth inch in diameter; they have a dull brown color. The head becomes cup-like at maturity and bears on the upper surface a large number of specialized spore structures or asci (singular, ascus) within each of which eight spores (ascospores) are produced. The ascospores mature just as the major blooming period of the azaleas begins. They are forcibly discharged into the air and are carried by air currents. Lighting on azalea flowers, they germinate in the presence of a film of water such as dew or rain-drops, and the germ tube penetrates the petal tissue, after which the lesion progresses from the fleck stage to limp blight as already described.

About the time the limp blight stage is reached the fungus produces a large number (often many thousand on a single petal) of a different kind of spore. There is only one crop of these spores on a given infected flower, but they may be numerous enough to cover its entire surface with a delicate

frost-like mat. These spores are easily detached and distributed by air currents, by splashing rain-drops and by insects, especially bumblebees, that visit the flowers. By these means they are widely and thickly spread. Each spore is capable of starting a disease spot that may eventually destroy a flower, and the crop of spores formed on only a few spotted flowers resulting from a primary ascospore infection, may be numerous enough to infect all the open flowers on nearby bushes.

The production of secondary spores continues throughout the period of azalea bloom, with some fluctuations depending on the weather, and finally ceases only when the warmer and drier weather of summer approaches or when there are no more azaleas in bloom. The sclerotial or dormant phase of the life cycle is then resumed.

The fungus attacks only the corolla or petals of the azalea flower and does not invade the calyx or seed capsule. Furthermore, it is incapable of developing on the leaves and twigs, although these parts may be superficially covered with spores during the period of flower infection. However, the secondary spores are short lived, and do not survive on the aerial parts of azaleas from one season to the next. Thus the seasonal cycle begins and ends with sclerotia on the ground, and so far as known this is the only means by which the fungus survives between flowering seasons.

Other hosts

The fungus (Ovulinia azaleae) is able to infect the flowers of rhododendrons, mountain laurel, and some species of Vaccinium or huckleberry. Numerous attempts artificially to infect flowers of other plants have failed. There have been some reports of the appearance of superficially similar spots on other flowers following the period of azalea bloom, but such spots were probably due to causes other than the azalea flower fungus; at any rate there is no scientific evidence that it can attack any plant outside the heath family, to which azaleas and rhododendrons belong.

Although the native azaleas of the Southeastern States, such as Azalea nudiflora, A. austrina, A. canescens, and A. calendulacea are susceptible to artificial infection by the flower spot fungus, this disease has not been found on these azaleas when growing in their native habitat well separated from cultivated azaleas. The fungus does not ordinarily form sclerotia in the flowers of the native azaleas, hence the only known means by which it is perpetuated is practically ruled out of consideration among the native species.

Dissemination of the fungus on plants

Since the sclerotia hibernate in the soil, it is evident that plants moved with undisturbed soil around their roots may carry the fungus with them. However, the sclerotia lie on or near the surface of the soil, and if the surface litter and all the loose soil are carefully removed, the risk of carrying the fungus is greatly reduced. Furthermore, if a thick (3 to 6 inches) mulch

of new leaf mold, leaf litter, or peat is spread over the root ball after an azalea is transplanted, the production of fruiting bodies from any sclerotia that may have been transported, or at least the discharge of spores, would probably be entirely suppressed. These precautions should be observed whenever an azalea is brought into a planting from a nursery or garden where the disease may have occurred.

Azaleas are often sold and transplanted while in full flower, and plants affected with this disease have frequently been seen in nurseries and plant stores. To set a plant in this condition in ones garden is an almost certain way to introduce the disease. Therefore azalea buyers should carefully examine the flowers of any plants they select and pick off and burn any that show suspicious spots. Besides this, the first crop of flowers should be carefully gathered and destroyed when they begin to drop, so that none of them remain on the ground where they can give rise to sclerotia.

Control

From what has already been said it is evident that the sclerotial stage is the most vulnerable phase in the life cycle of the fungus. If all the flowers could be gathered and burned before the sclerotia develop it would be possible to eradicate this fungus from an infested azalea planting within perhaps 1, or at the most 2 or 3 years (making allowance for sclerotia from previous flower crops that might have remained dormant in the ground). In practice it is extremely difficult, and in large plantings of azaleas practically impossible, to effect so thorough a clean-up of infected flowers. Since it theoretically takes only one surviving sclerotium to start the disease each spring, it is obviously necessary to attain a thoroughness of destruction of infected flowers far beyond the requirements of mere tidiness in even the most meticulously kept garden. Such a clean-up is all the more difficult where azaleas are grown (which is very proper from a cultural standpoint) with a mulch of leaf mold or leaf litter. At any rate, the removal and destruction of diseased flowers should be as thorough as practicable.

After the flowers have all fallen it would be advisable to rake off and burn the loose combustible mulch, then lay down a fresh mulch of leaf mold from a woodland or compost pile, or use sawdust or peat. On top of this a layer of oak leaves, 2 to 3 inches thick may also be placed. In case the mulch was not renewed after the flowering period, it may not be too late to do so during the winter at least a month before flowering begins; but ordinarily early renewal is preferable as there is a better chance of collecting all the fallen flowers, and with them the sclerotia, before they become buried in the soil.

As the flowers begin to appear, careful daily watch should be kept to detect and pick off any on which the early stages of the disease are recognized. In this way one may perhaps eliminate all or most of the primary infections and thus prevent an extensive multiplication of the fungus through secondary spores. Any gain at all in reducing the number of infected flowers, and hence the potential number of overwintering sclerotia, is worth striving for.

It would be very fortunate if some fungicidal application could be made to the ground surface beneath azaleas that would prevent the emergence of the fungus in spring, but no treatment of this sort is known that would not involve some risk to the plants. Experience has shown that sprays applied only to the foliage and buds in advance of blooming are entirely ineffective in protecting against the disease, since only the petals, hence the more or less open flowers, are susceptible to infection in any case.

Sulphur sprays or dusts in general are too low in toxicity to the flower spot fungus to offer much prospect of control. Sprays or dusts containing copper as the fungicidal ingredient may have some value provided the applications are made prior to or coincident with the period of ascospore discharge. Azalea flowers are not injured, and are only slightly discolored, by bordeaux mixture when made with not over 2 pounds of bluestone and 1 to 1½ pounds of lime to 50 gallons of water (or 2 ounces of bluestone, 1 to 1½ ounces of lime to 4 gallons of water). Proprietary copper sprays, such as are recommended for the control of black spot of roses, can be used in place of bordeaux mixture. A copper clay dust containing about 6 percent metallic copper with crude kaolin, or "Georgia clay" as a filler (to avoid lime, commonly so used, since lime is toxic to azaleas) has shown strong protective action against flower infection in laboratory tests, but failed to give control under natural conditions with a heavy primary infection.

Acetic acid, which is available in an inexpensive grade containing 80 percent pure acid, has also shown fungicidal possibilities with no appreciable toxic effect on azaleas when properly diluted. The 80 percent acid is diluted 1 part to 600 of water or 1 pint to 75 gallons; full strength (glacial) acetic acid should be diluted 1 part to 800, or 1 pint to 100 gallons of water.

Any of these materials, if tried, should be applied to the ground surface beneath the bushes, as well as lightly but thoroughly over the foliage, starting as soon as any buds show color and repeated at about 3-day intervals until the flowers are fully open.

It should be emphasized again that spraying or dusting is not recommended as a definite control measure. The only definitely proven control is by the complete elimination of overwintering sclerotia. Obviously, complete elimination is not feasible within 1 year in large gardens, nurseries, and extensive community plantings, though it has been practically attained in small, well isolated gardens. It is believed that some form of fungicidal treatment may be a valuable adjunct to the eradication of overwintering sources as a means of preventing primary infections, and the more promising methods are suggested for further trial by those who wish to cooperate in the efforts to develop an effective control for this disease.

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